

# Co-Packaged Optics & Optical Interconnects

## Patent Landscape Analysis – 2026

*Who are the key players and newcomers in the global IP race shaping the future of optical communication in semiconductor packaging?*

### REPORT OUTLINE

- CPO & Optical Interconnects
- Patent Landscape Analysis
- January 2026
- PDF > 80 slides
- Excel file > 1,300 patent families
- Reference: KM26001
- 4,990 EUR for a multi-user license



### KEY FEATURES

- **Global patenting trends**, including time evolution of patent publications, countries of patent filings, etc.
- **Main patent assignees and IP newcomers**
- Key players' **IP position** and the relative **strength** of their patent portfolio.
- **IP leadership evolution** of patent assignees since 2020.
- **IP profile of key players** (patent portfolio overview, technical coverage, geographical coverage, notable patents, recent IP activity)
- **Excel database** containing all patents analyzed in the report, including hyperlinks to an **updated online database**.

### RELATED REPORTS & MONITORS

[Hybrid Bonding Patent Landscape Analysis 2024](#)

### Co-packaged optics is now a key enabler of next-gen electronics

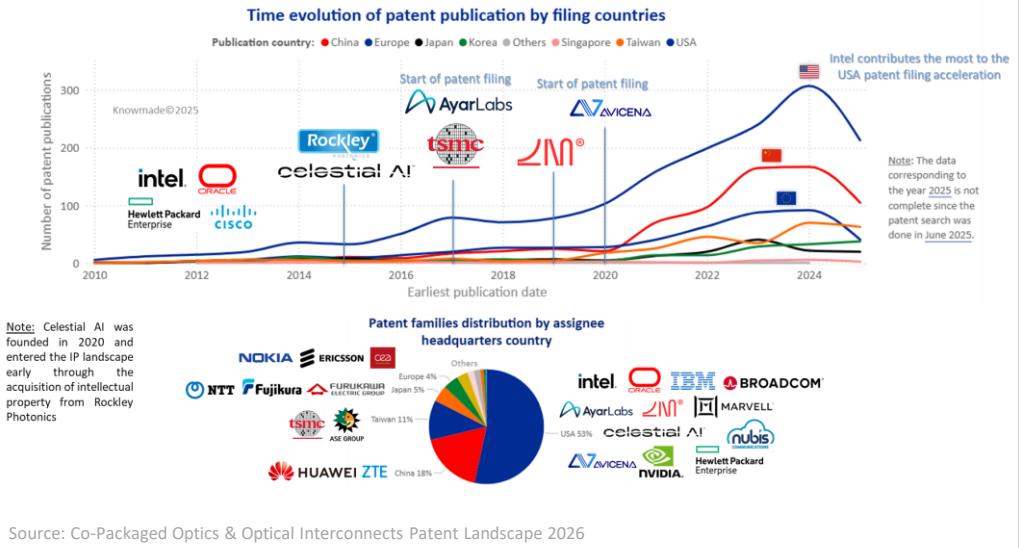
Artificial intelligence (AI) is reshaping industries at their core, fueling unprecedented data growth and accelerating the demand for energy-efficient computing. As data volumes surge, hardware innovation has become essential, particularly in rethinking data center architectures to deliver faster computation, lower power consumption, higher performance, and reduced latency. In this context, silicon photonics has emerged as a pivotal technology, replacing traditional copper interconnects with high-speed, light-based data transmission. As demand for data-intensive computing continues to rise, the semiconductor industry has built a substantial portfolio of patents aimed at integrating photonic and electronic systems at the package level. Together, these inventions highlight the industry's transition from conventional electrical interconnects to optical input/output (I/O) architectures that unlock higher bandwidth, lower latency, and improved energy efficiency across compute and networking platforms. Among the most significant advances is **Co-Packaged Optics (CPO)**, an innovative packaging approach that brings optical components directly into or near electronic devices to maximize efficiency and scalability.

Over the past 10 years, **CPO and optical I/O** technologies have become a key enabler of advanced semiconductor packaging, leading to a strong increase in patenting activity and a significant evolution of the competitive intellectual property (IP) landscape. **Major patent owners** have strengthened their IP positions in the US, China, and Europe, while **pure players** have entered the patent landscape. It is now crucial for companies operating in the semiconductor advanced packaging industry to closely examine the technology and competitive landscape from an IP perspective.

In this context, **Knowmade** is releasing a **new patent landscape report** to map the patent activity and competitive dynamics shaping this rapidly evolving field. Over **4,000 individual patents** from more than **1,300 patent families** (inventions) have been selected. This report aims to provide insights into current IP activities, the positions of key IP players, the applications they target in their patents, and how their patent portfolios can support their market strategies.

### Co-Packaged Optics & Optical Interconnects

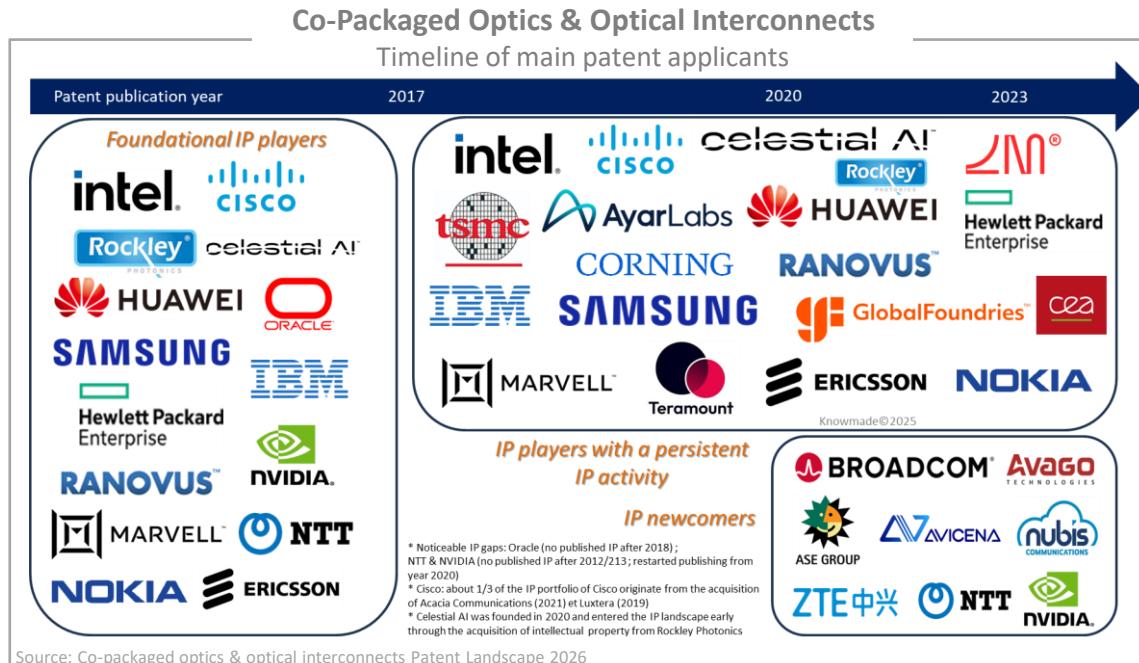
Patent publications by filing country and company headquarters



## Understanding the main trends, the key players' IP position and IP strategy

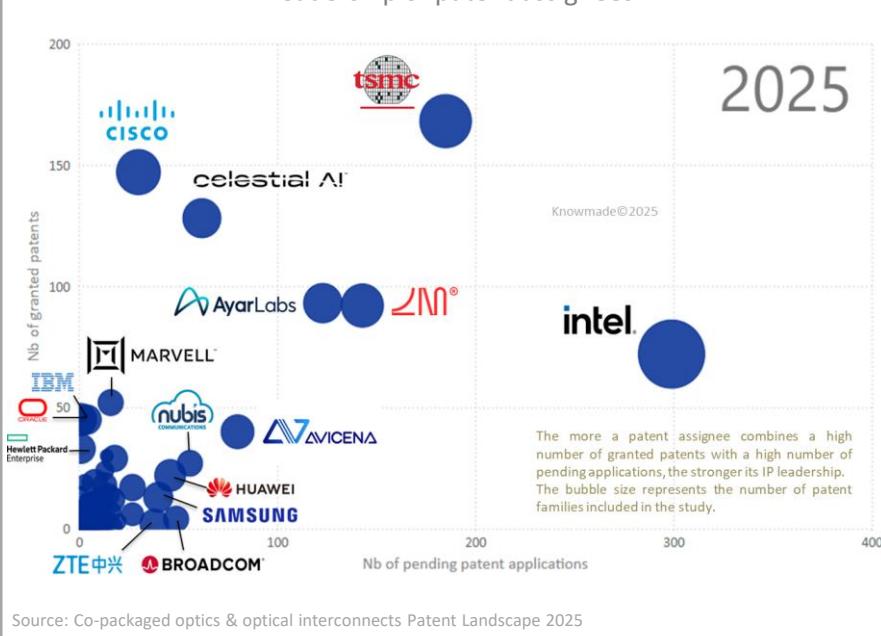
Through patent analysis, we describe the position of IP players, unveil their strategies to strengthen their IP portfolio, highlight their capability to limit the patenting activity and freedom-to-operate of other firms, identify promising new players, and forecast what would be the future IP leaders. IP competition analysis should reflect the vision of players with a strategy to enter and develop their business in the **advanced semiconductor packaging** market.

In this report, we provide a comprehensive overview of the competitive IP landscape and latest technological developments related to **CPO and optical I/O** technology. The report covers **IP dynamics** and **key trends** in terms of patents applications, patent assignees, filing countries, patented technologies, and targeted applications. It also identifies the **IP leaders**, most **active patent applicants**, and sheds light on **under-the-radar companies and new players** in this field. Besides, we have identified **over 270 key inventions** that are most critical in terms of geographic coverage in key technology markets.



## Co-Packaged Optics & Optical Interconnects

IP leadership of patent assignees



## A dynamic IP landscape: evolution of leading players' positions and pure players

TSMC and Intel are leading the patent landscape, increasing patenting activity, and expanding invention protection in key countries. As pioneer Intel has adopted an aggressive strategy to assert its patents. Later TSMC and **pure players** (Lightmatter, Celestial AI, Ayar Labs, Avicena Tech) joined the IP landscape and developed strategic portfolios.

In recent years, more IP players have become involved in the IP landscape, and OSATs and materials suppliers have entered the IP arena.

In this report, we provide an overview of the IP portfolios held by the key players emerging from the IP landscape and describe the related inventions and technologies.



## Useful Excel patent database

This report includes an extensive **Excel database** with all patents analyzed in this study, including **patent information** (numbers, dates, assignees, title, abstract, legal status, etc.) and **hyperlinks to an updated online database** (original documents, legal status, etc.).

## Companies mentioned in the report (non-exhaustive)

Intel, TSMC, Huawei, Broadcom, Cisco, Lightmatter, Avicena, Celestial AI, Rockley Photonics, Ayar Labs, Ranovus, Samsung Group, NVIDIA, Teramount, ZTE, Resonac, Marvell, Nokia, Oracle, Micron, Senko Group, VTT, Alphabet, Accelink Technologies, Ruijie Networks, Eliyan, Mitsubishi Electric, LIPAC, RTX Corporation, HP - Hewlett Packard Development, UniIC (Tsinghua Unigroup), Yangzhou Xinli Integrated Circuit, Juniper, Suzhou Singularity Photon Intelligent Technology, Huagong Tech, NCAP, CEA, ASTAR, Sumitomo Electric, JCET Group, Apple, GlobalFoundries, ASE Group, Nubis communications, Amkor Technology, Lightelligence, Zhejiang Lingxin Optoelectronics Technology, Corning, Zhongshan Meisu Technology, Nano Photonics, Guangbenwei Technology, Wuxi Institute of interconnect technology, Li Hong Electronic, Yongjiang Laboratory, SMIC, Tsinghua University, Sky Semiconductor, Elphic, Lightip Technologie, NTT - Nippon Telegraph & Telephone, Innolux, Shanghai Xizhi Technology, United Test and Assembly Center, University College Cork, Lumentum, Hanyang University, Furukawa Electric, Raytek, Hangzhou Guangzhiyuan Technology, Dongguan Luxshare Technology, PICAdvanced, SPIL, Wuhan Optics Valley Information Optoelectronics Innovation Center, MACOM Technology Solutions, Ciena, MaxLinear, AIP - Advanced Integrated Photonics, Lyte AI, Browave, Xunyun Electronic Technology, Xperi/Adeia, HKUST - Hong Kong University of Science And Technology, ITRI - Industrial Technology Research Institute.

## TABLE OF CONTENTS

<b>INTRODUCTION</b>	<b>5</b>	<b>IP PROFILE OF A SELECTION OF PATENT ASSIGNEE</b>	<b>36</b>
• Context and objectives of the report		For each player:	
• Scope of the report		– Patent portfolio overview (IP dynamics, segments, legal status, geographic coverage, etc.)	
• Definitions		– Description of notable patents	
• Reading guide		• Intel	37
• Excel database		• TSMC	43
<b>EXECUTIVE SUMMARY</b>	<b>12</b>	• Avicena	48
<b>PATENT LANDSCAPE OVERVIEW</b>	<b>21</b>	• Samsung	51
• IP dynamics		• Cisco	57
• Time evolution of patent publications by company HQ		• ASE Group	62
• Main patent assignees (general, core inventions, dynamics)		• Broadcom (Avago)	66
• Timeline of main IP players		• Ayar Labs	69
• Main IP players and current legal status of their patents		• Celestial AI	73
• IP leadership (general 2020 & 2025, 2025 core inventions)		• Lightmatter	78
• Geographic coverage of active patents (general, core inventions)			
• Domestic vs. Global IP strategies (global IP and core inventions)			
• Patent families with a strategic geographic coverage			
<b>ANNEX</b>	<b>83</b>		
• Methodology for patent search, selection and analysis			
• Terminology			
<b>KNOWMADE PRESENTATION</b>	<b>88</b>		

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## ABOUT KNOWMADE

**KnowMade** is a technology intelligence and IP strategy firm specializing in the analysis of patents and scientific publications. We assist innovative companies, investors, and research organizations in understanding the competitive landscape, anticipating technological trends, identifying opportunities and risks, improving their R&D, and shaping effective IP strategies.

**KnowMade**'s analysts combine their strong technology expertise and in-depth knowledge of patents with powerful analytics tools and methodologies to transform patent and scientific data into actionable insights to support decision-making in R&D, innovation, investment, and intellectual property.

**KnowMade** has solid expertise in Semiconductors and Packaging, Power Electronics, Batteries and Energy Management, RF and Wireless Communications, Photonics, MEMS, Sensing and Imaging, Medical Devices, Biotechnology, Pharmaceuticals, and Agri-Food.

# ORDER FORM

## Co-Packaged Optics & Optical Interconnects

### Patent Landscape Analysis – 2026

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#### PRODUCT ORDER

**4,990 EUR – Multi user license\***

For price in dollars, please use the day's exchange rate.

For French customer, add 20% for VAT.

All reports are delivered electronically in pdf format at payment reception.

\*The report can be shared with the employees of the company purchasing the report. Subsidiaries and joint-ventures are excluded. Please be aware that the report is watermarked on each page, with the name of the recipient and the organization (the name mentioned in the PO). This watermark also reaffirms that report sharing is not allowed.

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**Signature:**

# TERMS AND CONDITIONS OF SALES

## Definitions

“Acceptance”: Action by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by signing the purchase order which mentions “I hereby accept KnowMade’s Terms and Conditions of Sale”.

“Buyer”: Any business user (i.e. any person acting in the course of its business activities, for its business needs) entering into the following general conditions to the exclusion of consumers acting in their personal interests.

“Contracting Parties” or “Parties”: The Seller on the one hand and the Buyer on the other hand.

“Intellectual Property Rights” (“IPR”) means any rights held by the Seller in its Products, including any patents, trademarks, registered models, designs, copyrights, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights or similar in any part of the world, notwithstanding the fact that they have been registered or not and including any pending registration of one of the above mentioned rights.

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1. Single user license: a single individual at the company can use the report.

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“Products”: Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

“Seller”: Based in Sophia Antipolis (France headquarters), KnowMade is a technology intelligence company specialized in the research and analysis of scientific and technical information. We provide patent landscapes and scientific state of the art with high added value to businesses and research laboratories. Our intelligence digests play a key role to define your innovation and development strategy.

## 1. Scope

1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. Any additional, different, or conflicting terms and conditions in any other documents issued by the buyer at any time are hereby objected to by the seller, shall be wholly inapplicable to any sale made hereunder and shall not be binding in any way on the seller.

1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorized person representing the Buyer. For these purposes, the Buyer accepts these conditions of sales when signing the purchase order which mentions “I hereby accept KnowMade’s Terms and Conditions of Sale”. This results in acceptance by the Buyer.

1.3 Orders are deemed to be accepted only upon written acceptance and confirmation by the Seller, within [7 days] from the date of order, to be sent either by email or to the Buyer’s address. In the absence of any confirmation in writing, orders shall be deemed to have been accepted.

## 2. Mailing of the Products

2.1 Products are sent by email to the Buyer:

- within [1] month from the order for Products already released; or

- within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 Some weeks prior to the release date the Seller can propose a pre-release discount to the Buyer.

The Seller shall by no means be responsible for any delay in respect of article 2.2 above, and including in cases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.

2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 The mailing is operated through electronic means either by email via the sales department. If the Product’s electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

2.6 No return of Products shall be accepted without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information to the Seller as required under article 2.5 shall remain at the Buyer’s risk.

## 3. Price, invoicing and payment

3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are expressed to be inclusive of all taxes. The prices may be reevaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.

3.2 Payments due by the Buyer shall be sent by cheque payable to KnowMade, PayPal, or by electronic transfer to the following account:

Banque Populaire Méditerranée, CAP 3000 Quartier du lac, 06700 St Laurent du Var

BIC or SWIFT code: CCBPFRPPMAR

IBAN: : FR76 1460 7003 6360 6214 5695 139

To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

## 4. Liabilities

4.1 The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.

4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

4.3 In no event shall the Seller be liable for:

a) damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller's website or the Products, or any information provided on the website, or in the Products;

b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.

4.7 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the orders, except for non-acceptable delays exceeding [4] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of saleability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

## 5. Force majeure

The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

## 6. Protection of the Seller's IPR

6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.

6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company. The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

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- Recordings and re-transmittals over any network (including any local area network);
- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;
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6.3 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

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7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.

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